GOVERNMENT OF WESTERN AUSTRALIA

Landgate

Landgate Requirements for Placement of Geodetic Survey Marks

GSU-01

Locate Value Secure

Survey | September 2025

Document control

Landgate Requirements for Placement of Geodetic Survey Marks

Produced and published by: Location Services/Land Boundaries

Document version history

Date	Author	Version	Revision Notes
Sept 2025	Khandu	6.0	Changed title from “Placement of Geodetic Marks” to “Landgate Requirements for Placement of Geodetic Survey Marks” and minor revisions.
April 2025	Survey	5.0	Changed title from “Placement of Standard Survey Marks (SSMs)” to “Placement of Geodetic Marks” Benchmark placement added Appendices added and rearranged
Sept 2023	Survey	4.0	Update to new style and refresh hyperlinks Appendix C added
	Survey	1.0	Initial

Table of contents

1. Preface

The installation of Landgate Geodetic Marks is to be in accordance with ICSM Standard for the Australian Control Network (SP1 v2.2) and Guideline for Installation and Documentation of Survey Control Marks (SP1 v2.2). The Landgate requirements shall take precedence over provisions in SP1 v2.2 where there is inconsistency between the two.

2. Definitions and abbreviations

Abbreviation	Definition
BM	Bench Mark
DRM	Distant Reference Mark
Geodetic Survey Mark	SSM, BM or RM
Primary Mark	SSM or BM
RM	Reference Mark
RTK	Real Time Kinematic
SSM	Standard Survey Mark
VRS	Virtual Reference Station

3. Site requirements

The placement of Standard Survey Marks (SSMs) and Bench Marks (BMs) should be situated to meet the following minimum conditions:

- **Long-term stability and durability** – The site should ensure that the SSM or BM remains stable and durable over time, and is least likely to be disturbed, damaged, destroyed.
- **Accessibility** – The site should be easy to access and occupy.
- **Minimum vegetation clearing** – Prefer locations that require little to no vegetation clearing (present and future).
- **Public safety** – The site should present minimal risk to public safety.

Additional requirements for SSMs:

- **Clear sky view** – The location should provide a reasonable clear view of the sky to support GNSS observations, minimising obstructions from trees, buildings, or other structures as much as practicable.
- **Minimal radio frequency interference** – Avoid areas near sources of strong radio frequency interference (e.g., near radio or television broadcast towers).

Note –

a) Avoid placing Geodetic marks close to service corridors.

b) Geodetic marks should be located at a sufficient distance from any potential earth works to prevent future damage and/or disturbance to the mark.

4. Placement of Geodetic Survey Marks

A SSM or BM shall consist of a monument provided by Landgate or a *brass plaque set in concrete*, and installed in accordance with the construction drawings provided in Appendix A, B or C.

A hatch cover is required in built-up or planned for development areas, or where the Geodetic Survey Mark may be at risk or pose a risk to public safety.

Reference Marks (RMs) are required for both SSMs and BMs and they shall be installed as per the construction drawing provided in Appendix D.

4.1 Standard Survey Marks (SSMs)

4.1.1 The Landgate provided unique mark identifier shall be stamped on the brass plaque. See construction drawings in **Appendix A** or **Appendix B** for different types of installation designs depending on ground conditions.

4.1.2 The SSM monument and hatch cover when installed, must not be connected allowing for the hatch to move independently of the mark.

4.1.3 A metal reinforced precast monument and hatch cover is preferred. If a precast mark is not available, only good quality reinforced concrete of a minimum 20 MPa should be used for the construction of SSM.

4.1.4 A minimum of three (3) Reference Marks (RMs) shall be placed around the SSM preferably at 120º separation and at least 0.2 m below the natural ground surface, approximately 3 to 5 metres away from the SSM. The RMs should be of 13 mm diameter mild steel rods of sufficient length to ensure stability (0.6 m preferred) and surrounded by a 0.2 m diameter concrete collar of at least 0.25 m in depth (see **Appendix D**).

4.1.5 Measure and record the height difference from the SSM monument to ground level. Where a hatch cover is installed, measure the height difference from the hatch cover to the SSM monument and ground level (see **Appendix A**).

4.1.6 A Landgate provided witness plate (WP) shall be installed on a star iron picket or a suitable nearby fixture (e.g., fence) near the SSM. The distance and bearing to the SSM are to be stamped onto the WP. ***Where public safety may be compromised, the requirement for a witness plate can be waived.***

4.1.7 In built-up environments where witness plates are not suitable, SSM lettering and a broad arrow pointing to the mark can be stencilled onto the kerb or roadway using a yellow paint (see **Appendix F**).

4.2 Bench Marks (BMs)

4.2.1 The Landgate provided unique mark identifier shall be stamped on the brass plaque. See construction drawings in **Appendix A** or **Appendix B** for different installation designs.

4.2.2 For a **deep-seated** Bench Marks, the requirements are provided in **Section 4.3**.

4.2.3 The BM monument and hatch cover when installed, must not be connected allowing for the hatch to move independently of the mark.

4.2.4 A metal reinforced precast monument and hatch cover is preferred. If a precast mark is not available, only good quality reinforced concrete of a minimum 20 MPa should be used in the construction of the BM.

4.2.5 A minimum of two (2) Reference Marks (RMs) shall be placed on-line with the BM with one (1) on either side and at least 0.2 m below the natural surface, approximately 10 to 15 metres away from the BM. The RMs should be of 13 mm diameter mild steel rods of sufficient length to ensure stability (0.6 m preferred) and surrounded by a 0.2 m diameter concrete collar of at least 0.25 m in depth (see **Appendix D**).

4.2.6 Measure and record the height difference from the BM monument to ground level. Where a hatch cover is installed, measure the height difference from the hatch cover to the BM monument and ground level (see **Appendix A**).

4.2.7 A Landgate provided witness plate shall be installed on a star iron picket or a suitable nearby fixture near the BM. The distance and bearing to the BM are to be stamped onto the witness plate. ***Where public safety may be compromised, the requirement for a witness plate can be waived.***

4.2.8 In built-up environments where witness plates are not suitable, BM lettering and a broad arrow pointing to the mark can be stencilled onto the kerb or roadway using yellow paint (see **Appendix F**).

4.3 Deep-seated Bench Marks

4.3.1 Deep-seated BMs are installed in areas of expansive soils to provide added stability and minimise vertical displacement of the BM. See requirements in the construction drawing in **Appendix C**.

4.3.2 The monument consists of stainless-steel rods with lengths of 1 m and 0.5 m, driven into the ground until refusal is reached. A driver end is used to install the rod string, with a point attached to the first rod. Loctite is applied to bond the rods forming the final string. Once installed, the driver end is replaced with a top cap, which is also glued in place.

4.3.3 A hole is drilled using an auger, and a 40 mm diameter PVC pipe is driven into the hole. This pipe isolates the rod from surrounding ground material, helping to prevent movement caused by seasonal soil changes.

4.3.4 Follow requirements outlined from **Clause 4.2.5** to **4.2.8**.

5. Reference Marks

Reference Marks should be of 13 mm diameter mild steel rods of sufficient length to ensure stability (0.6 m preferred) and surrounded by a 0.2 m diameter concrete collar of at least 0.25 m in depth (see Appendix D).

Where subsurface installation is impractical, alternative types of RMs may be used (e.g., 200 mm spikes in bitumen, bridge nails in bitumen, masonry nails in concrete etc.). These alternatives must be selected and placed with consideration for long-term stability and positioned to allow verification of the SSM's stability.

Additionally, these alternative RMs must support unambiguous height measurement with a levelling staff. *RMs should not be placed on fence posts, power poles, kerbs, brick paving or cracks in concrete*. If masonry nails are used, they should be of the hammer interference fit anchor type installed into a drill hole (for example Ramset Shuredrive™). Concrete nails should only be used in medium hardness materials that allows the nail to be driven in without distortion.

5.1 SSMs

5.1.1 All distances between the SSM and RMs, and between RMs must be measured and recorded to three (3) decimal places. Differences greater than 5 mm between measured and calculated distances are not acceptable.

5.1.2 Bearings from the new SSM to each RM are to be recorded to at least 10 seconds of arc. These bearings should be oriented to true azimuth by observing an angle from a nearby known point within the geodetic network. If no suitable known mark is available, true azimuth may be established by observing to a distant reference mark (DRM) using GNSS techniques (e.g., static or rapid static baseline or RTK / VRS). The DRM should be placed at a location sufficiently distant from the Primary Mark to ensure reliable azimuth determination. The distance from Primary Mark to the DRM should be measured and recorded.

5.1.3 The height difference between the SSM and the RMs must be accurately measured using a spirit level (digital or optical) and a staff. The observation method needs to ensure that errors caused by incorrect placement of the staff foot on the mark are eliminated, and that measurement redundancy is achieved. Total Station can be used for determining height differences for RMs, however, the survey method must be detailed in the report, and the instrument height, reflector height and collimation errors are reduced (2 face measurement) so that the height differences obtained achieve accuracies expected of a conventional levelling technique. For more details, refer to ***GSU-03 – Landgate Requirements for Geodetic Surveys by Differential Levelling***.

5.1.4 Measure and record the height difference from the RMs to ground level.

5.1.5 RMs must be numbered consecutively clockwise with number 1 being assigned to the first RM as viewed clockwise from north. The same numbering system is applied when additional new RMs are installed for existing marks.

5.1.6 The use of GNSS (including RTK and VRS) is not acceptable for the measurement of RMs. However, they can be used as a check.

5.2 BMs

5.2.1 All distances between the BMs and RMs must be measured and recorded to a minimum of two (2) decimal places.

5.2.2 Bearings from the new BM to each RM are to have a minimum of a magnetic bearing and be recorded to at nearest 1º of arc.

5.2.3 The height difference between the BM and the RMs must be accurately measured using a spirit level (digital or optical) and a staff. The observation method needs to ensure that errors caused by incorrect placement of the staff foot on the mark are eliminated, and that measurement redundancy is achieved. Total Station can be used for determining height differences for RMs; however, the survey method must be detailed in the report, and the instrument height, reflector height and collimation errors are reduced (2 face measurement) so that the height differences obtained achieve accuracies expected of a conventional levelling technique. For more details, refer to ***GSU-03 – Landgate Requirements for Geodetic Surveys by Differential Levelling***.

5.2.4 Measure and record the height difference from the RMs to ground level.

5.2.5 RMs must be numbered consecutively clockwise with number 1 being assigned to the first RM as viewed clockwise from north. The same numbering system is applied when additional new RMs are installed on existing marks.

5.2.6 The use of GNSS (including RTK and VRS) is not acceptable for the measurement of RMs.

6. Documentation and reporting

6.1 Access sketch

6.1.1 An access sketch must be drawn during the time each new SSM or BM is established. The sketch shall provide enough information to easily locate the mark in the future. This includes but not limited to:

- Location of the mark in relation to nearby permanent features (e.g., trees, roads, buildings, fences, utility poles and/or settings, etc.)
- Include distances from the SSM/BM and/or RMs to nearby permanent features, if reasonable, for easy recovery.
- Show access routes (e.g., driveways, tracks, gates, house/lot no) and any obstacles (e.g., locked gates, fences) where applicable.

6.1.2 A sketch of the RMs showing all the observations (distances, angles/bearings, and height differences) including numbering of RMs, depth and type of RMs installed.

6.2 Station summary

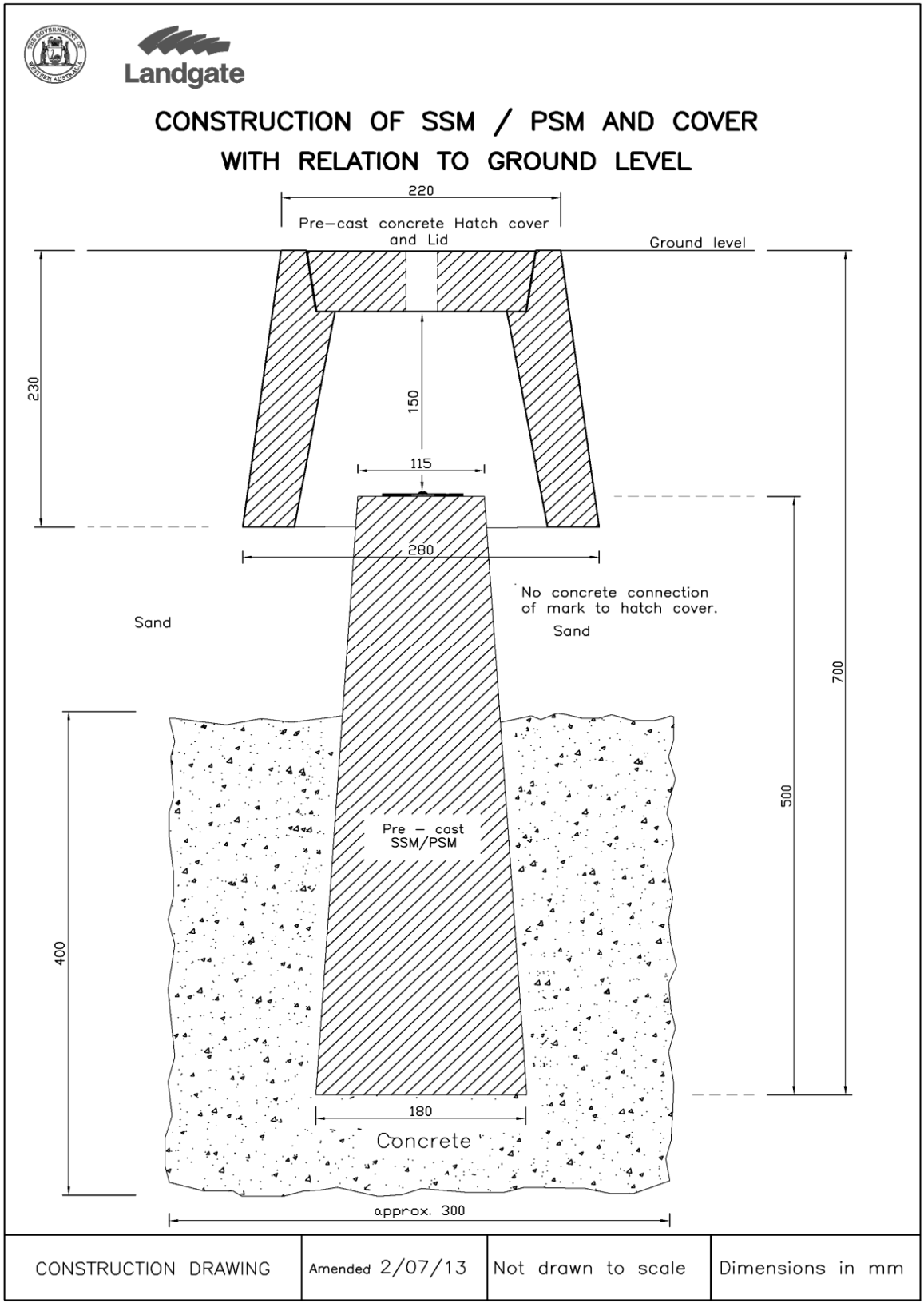
6.2.1 Each access sketch must be transferred to a digital format in a Station Summary template provided by Landgate. The Station Summary template is drawn in AutoCAD® and dwg is the preferred file format.

6.2.2 The requirements are provided in ***GSU-07 – Landgate Specifications for Drafting Geodetic Survey Mark Station Summaries***.

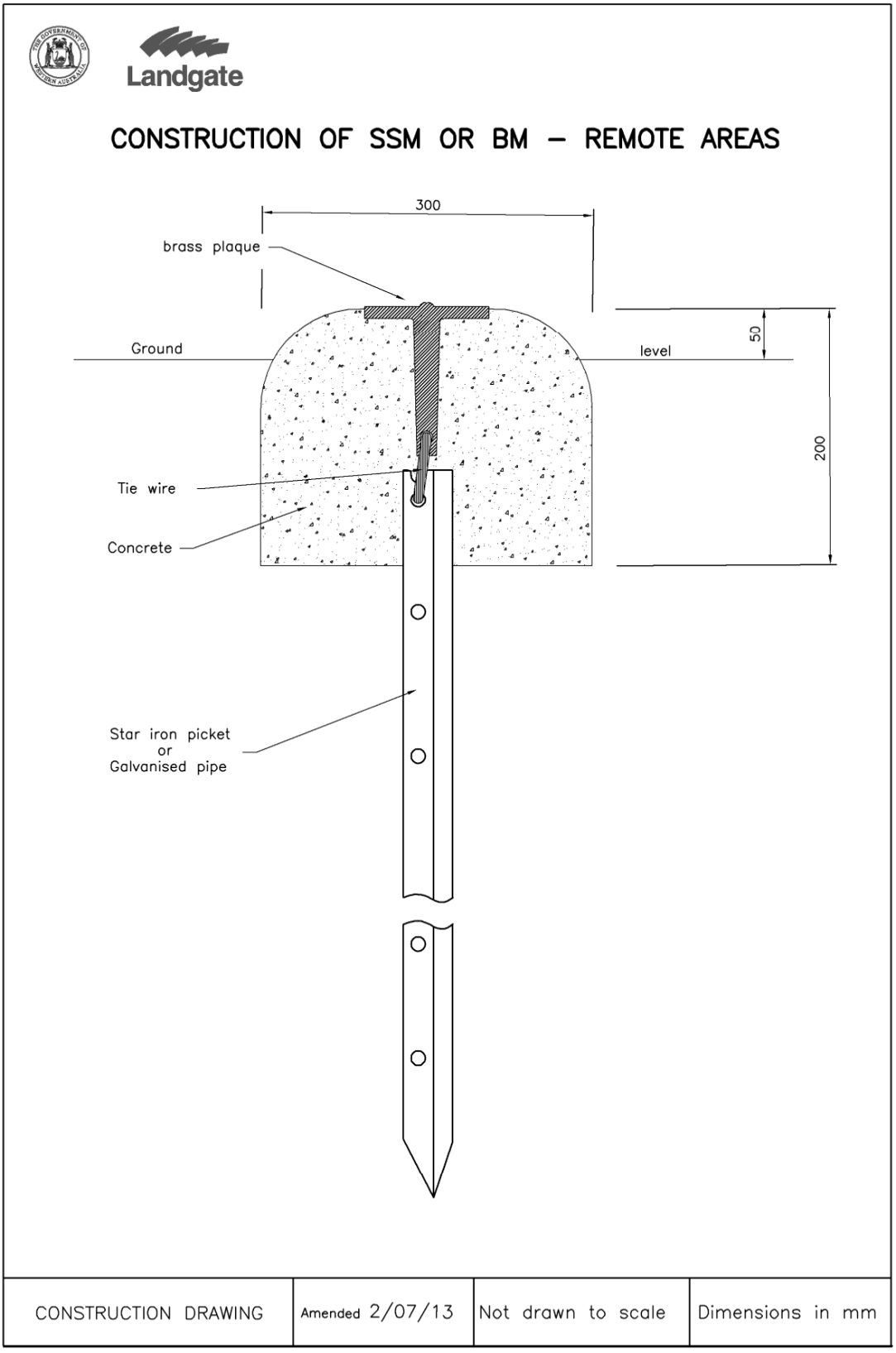
6.3 Survey

6.3.1 The documentation and reporting requirements for horizontal and vertical surveys are provided in ***GSU-02 – Landgate Requirements for Geodetic Surveys using GNSS*** and ***GSU-03 – Landgate Requirements for Geodetic Surveys by Differential Levelling***, respectively.

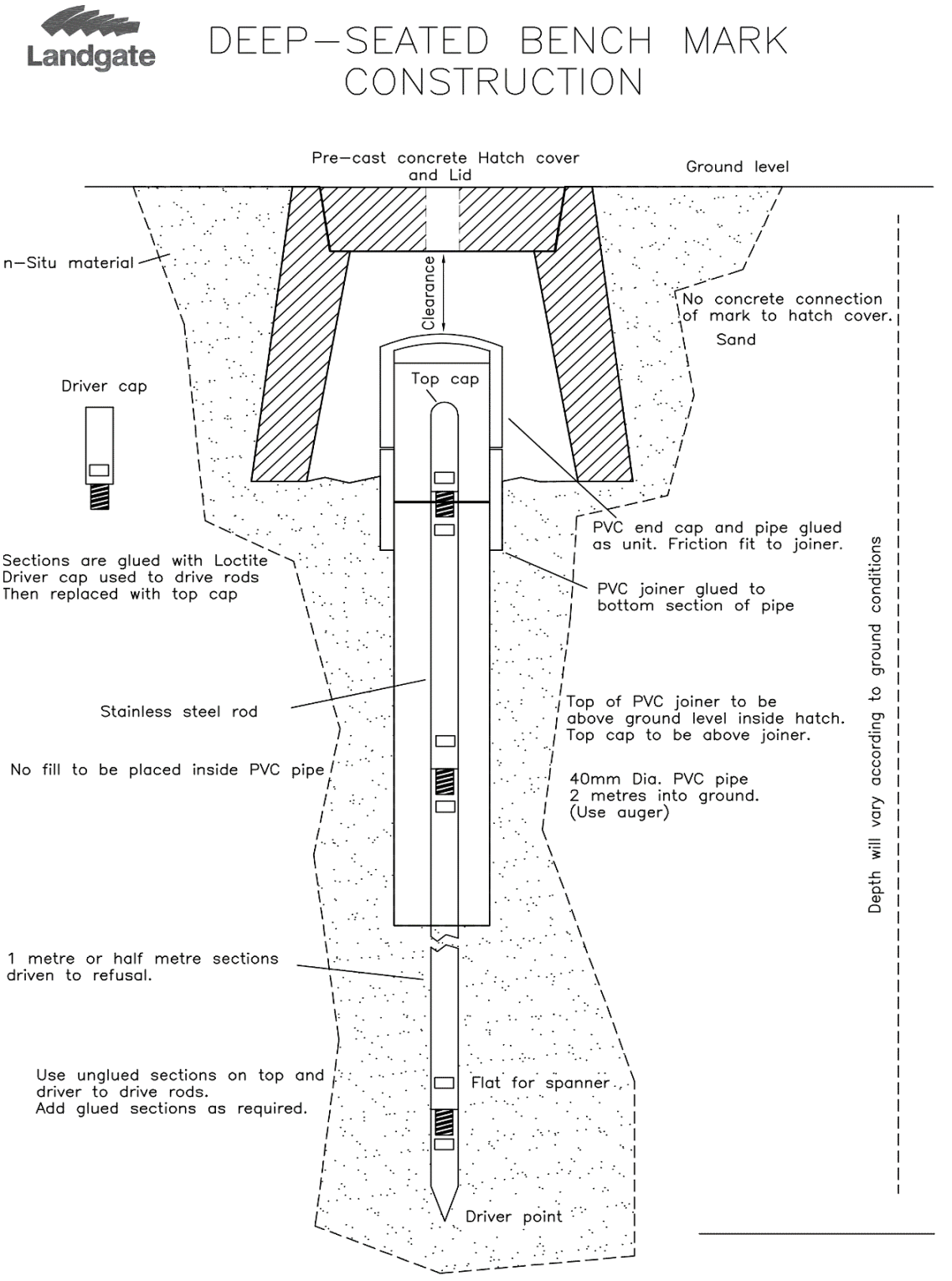
7. Appendix A - Installation of Precast Mark



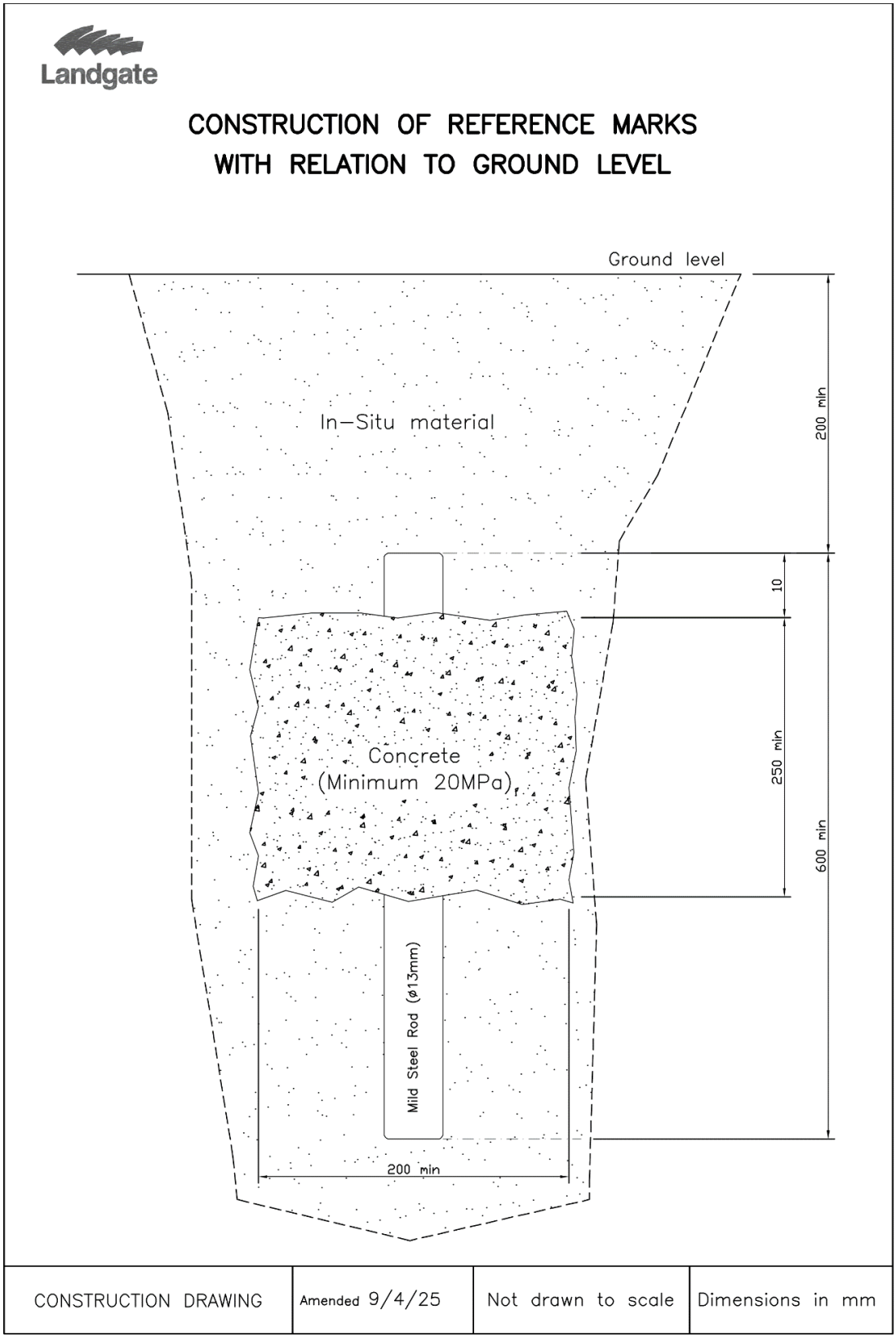
8. Appendix B - Installation of Brass Plaque



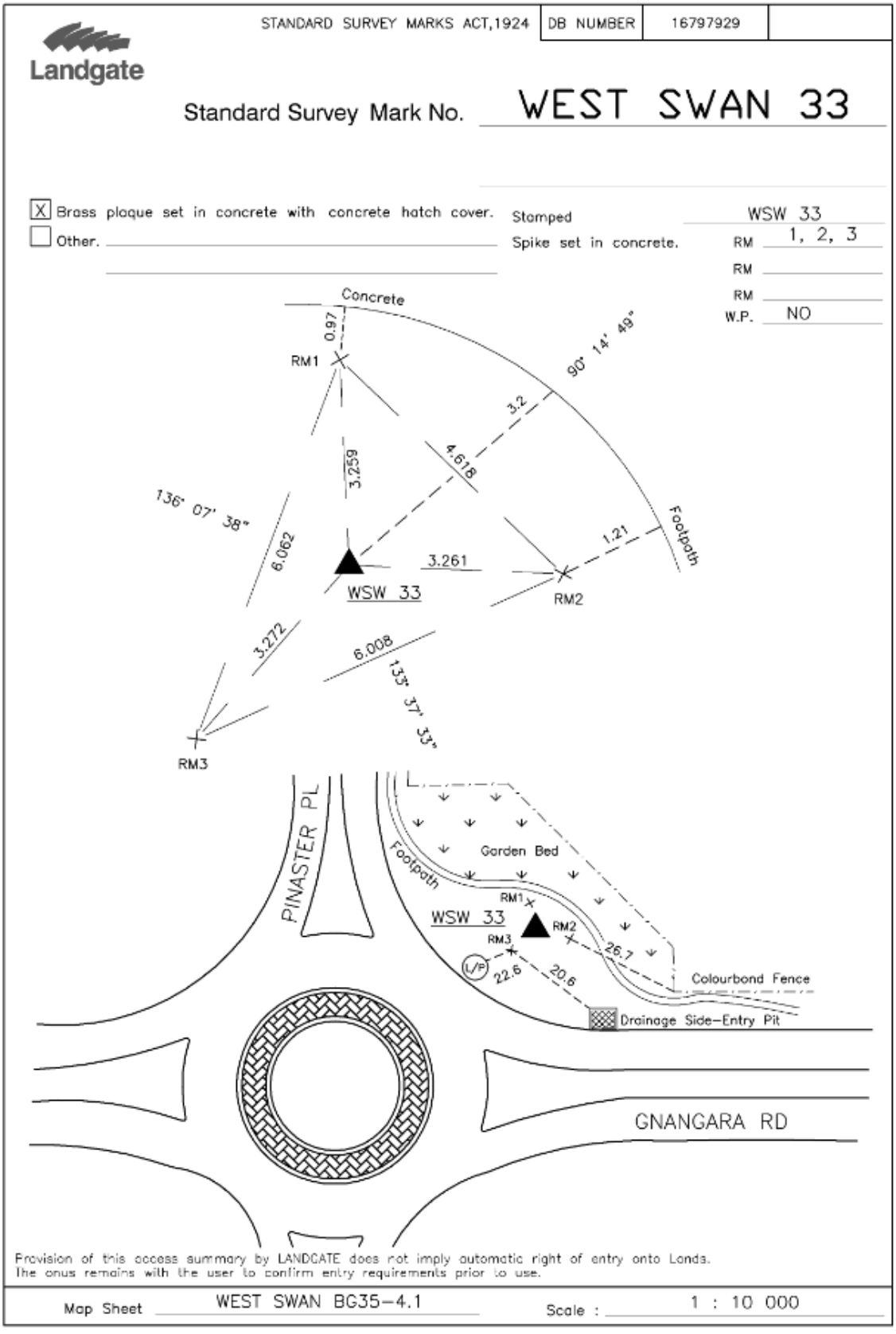
9. Appendix C - Installation of Deep-Seated Mark



10. Appendix D - Installation of Reference Marks



11. Appendix E – Example of Station Summary



12. Appendix F – SSM/BM Stencil Template

STANDARD SURVEY MARKS ACT,1924 | DB NUMBER

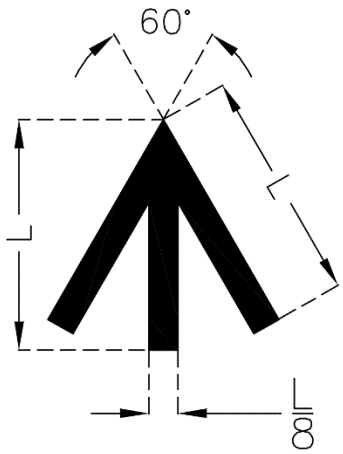
Landgate

Mark No. SSM & BM

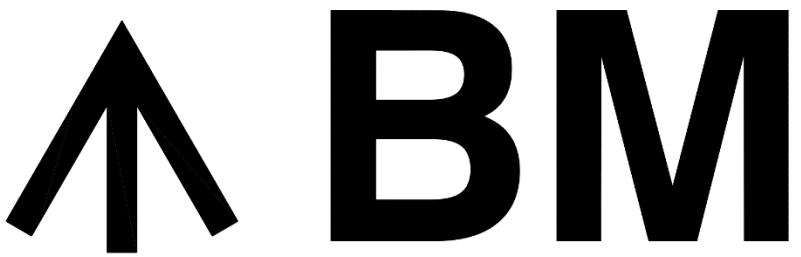
STENCIL TEMPLATE

☐ Brass plaque set in concrete with concrete hatch cover.
☐ Other. _____

Stamped _____
Spike set in concrete.
RM _____
RM _____
RM _____
W.P. _____



Stencils need to have a broad arrow not exceeding 0.1m in height "L". Text to be "Helvetica Bold" with a font size not exceeding 0.1m in height.



Provision of this access summary by LANDGATE does not imply automatic right of entry onto Lands.
The onus remains with the user to confirm entry requirements prior to use.

Map Sheet _____ Scale : N.T.S

Western Australian Land Information Authority ABN 86 574 793 858 QR 07/1